Geophysical Research Abstracts
Vol. 21, EGU2019-1037, 2019
EGU General Assembly 2019

Assessment of Covariance Estimation through Least Squares Collocation over Iran

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In our previous work [Ramouz et al. 2018], during the gravity field determination via Least Squares Collocation (LSC) in Iran, it was detected that localizing covariance modeling shows better performance than using one uniform covariance for all the under investigation regions. Now the question is which criteria should be used for dividing the region into subareas for localization the covariance estimation? Tscherning et al. 1994 stated that data distribution could significantly affect the covariance estimation and consequently the LSC gravity modeling. As Iran has a rough topography and at the same time suffers from lack of a good coverage and homogenous terrestrial gravity network, covariance analysis in this area is not a trivial task.
Four local case studies with different roughness and data distributions but with the same window size were selected. In each case study and based on Remove – Restore technique, the global and topographic parts of the gravity signal were removed from the observations. To do so, global gravity model EIGEN-6C4 up to d/o 360 and RTM method with the topographic information supplied by SRTM 1 arc-second height model, were used respectively. After that, residual gravity anomalies went through analytical covariance estimation by make use of Tscherning – Rapp 1974 covariance model.
Indeed, covariance estimation in LSC method consists of two steps: calculation of an empirical covariance function from the residual gravity anomalies, and fitting an analytical covariance model to it. In this study, we focus on the considerations about data and its distribution which must be taken into account during empirical and analytical covariance determination. In case of not well-distributed input data, excavating analytical covariance model parameters is a challenging task. In some cases, this sensitivity causes difficulty even in choosing initial values for inverse adjustment of these parameters, which improper initial values lead to wrong parameters selections. Also, the distribution of data in each case study was manipulated to analyze its influence on the covariance estimation.
To make an assessment, in each case study, the residual gravity anomalies were split into two datasets; first as observations input for LSC, and the second, as control points to evaluate the accuracy of the LSC gravity modeling and the covariance estimation. Then the interdependency and effect of Tscherning – Rapp covariance model parameters on the covariance estimation were investigated in each case study. Evaluation of the results in the case studies shows that the accuracy of the gravity modeling, directly dependent on the distribution of the data and the roughness of the topography, among other parameters. Finally, enhancing the covariance estimation based on presented approach, lead to about 10% improvement of the accuracy in terms of STD through LSC gravity modeling.